

# PATENT SPECIFICATION (11)

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## (54) SHEET STACKING METHOD AND APPARATUS

(71) We, XEROX CORPORATION, of Rochester, New York State, United States of America, a body corporate organized under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a sheet delivery and propelling device for stacking sheets of cut material in alignment within a collecting tray.

More specifically, this invention relates to a sheet handling process and device suitable for use in an automatic copying machine for delivering and stacking sheets of material within a collecting tray. With the advent of the xerographic process has come an increased demand for more compact and higher speed office copying machines which are capable of processing cut sheets of material. As these machines attain higher speeds, the sheet handling requirements imposed on the apparatus have similarly increased. This is particularly true in machine environments where the finished copies must be rapidly fed into a final collecting tray, bin or the like. It has been found that delivering individual cut sheets of material rapidly into a relatively confined space such as a collecting tray causes the sheets to curl or become misaligned which may ultimately result in the sheets either "walking" out of the tray area or backing up into the sheet delivery mechanism. Even where the sheets remain within the collecting area, the sheets tend to become so misaligned that the operator is forced to restack the sheets upon their removal from the machine thus increasing, rather than decreasing, the work load imposed upon the machine user.

Some paper handling devices have been devised for stacking sheets of cut material as they are delivered into a collecting tray as exemplified by U.S. Patents 3,630,515 and 3,669,447. In general, most of these prior art devices involve sheet handling mechanisms which are relatively bulky, complex, and incapable of uniformly acting upon the sheets as the size of the stack changes.

According to the present invention there is provided a method of stacking sheets of material within a collecting tray including positioning an extended resilient member in close proximity to the collecting tray whereby the extended portion of the member is capable of contacting sheets delivered therein, rotating the outwardly extending member whereby the extended portion of the member strikes each sheet delivered into said tray to register the sheet therein, deforming the resilient member to a loaded condition prior to bringing the member into striking contact with the sheet, and releasing the loaded member whereby the energy stored therein is imparted to the sheet upon contact.

The present invention also comprehends a device for aligning sheets of material that are delivered into a collecting tray including a rotating means positioned adjacent to the collecting tray having at least one resilient member operatively associated therewith being arranged to turn with the rotating means, the resilient member extending outwardly from said rotating means in a generally radial direction to contact a sheet of material delivered into said tray to propel the sheet into alignment, means to deform the resilient member into a loaded condition prior to the resilient member contacting said sheet, and means to release the deformed resilient member against the sheet whereby the energy stored within said resilient member is imparted to the sheet to effect alignment thereof.

The device of the present invention may be in the form of a sheet delivery and stacking apparatus comprising a pair of co-operating feed rolls, which are arranged to advance cut sheets of final support material, introduced into the nip formed by the rolls, the apparatus further including at least one sheet stacking element operatively associated with one of the feed rolls so as to turn therewith, the stacking element having a resilient arm extending outwardly from the roll in a generally radial direction being arranged so that the arm is deformed as it is drawn through the nip and is released, upon passage through the nip, into contact with the uppermost sheet delivered into the tray to impart the energy stored in the arm to

the sheet thus effecting alignment of the sheet within the tray.

For the avoidance of doubt, it is pointed out that, when apparatus in accordance with the invention is said to comprise a pair of cooperating pinch or feed rolls having a nip formed by the rolls, each one of said pair, independently of the form of the other one of said pair, may comprise either a single roll or a plurality of axially aligned roll members; and the nip is to be regarded as extending continuously across the full axial width of said pair of rolls. Thus, for example, gaps can exist between such roll members as aforesaid, and in such cases the nip is to be regarded as extended across such gaps.

For a better understanding of the invention, reference is had to the following detailed description of a preferred embodiment of the invention to be read in connection with the accompanying drawings, wherein:

Figure 1 is a schematic representation of an automatic xerographic copying device incorporating apparatus in accordance with the present invention;

Figure 2 is a partial perspective view showing a sheet handling apparatus in accordance with the present invention as utilized in the automatic copying device illustrated in Figure 1;

Figures 3 to 5 are partial sectional views showing the various steps of loading the flapper element and bringing the element into contact with sheets stored within a collecting tray.

Referring now to Figure 1, there is shown an automatic xerographic reproducing machine incorporating the sheet delivery and stacking mechanism of the present invention. The copying machine illustrated employs an image recording drum member 10 having an outer surface thereon coated with a suitable photoconductive material 11. Any suitable material, such as selenium or the like, capable of supporting an electrostatic latent image thereon can be used to coat the drum surface. The drum, which is journaled for rotation within the machine frame by means of a shaft 12, is rotated in the direction indicated so as to transport the photoconductive recording surface through a plurality of xerographic processing stations. Although not shown, it should be understood that suitable means are also provided to both drive and coordinate the movement of the various machine components whereby a faithful rendition of the original to be copied is created upon the drum surface and recorded on a cut sheet of final support material.

Since the practice of xerography is well known in the art, the various processing stations for producing a copy are herein

represented in Figure 1 as a series of block diagrams delineated A to E. At station A, an electrostatic charge is uniformly placed upon the photoconductive surface preparatory to the surface receiving a light image of the original to be recorded. The charged drum is then moved through an exposure station B containing a scanning apparatus wherein a flowing light image of a stationary original 14 is recorded upon the photo-receptor in the form of a latent electrostatic image.

Next, in the direction of drum rotation, the image bearing plate surface is transported through a developing station C wherein toner material is applied to the charged surface thereby rendering the latent electrostatic image visible. The now developed image is brought into contact with a sheet of final support material, such as paper or the like, within a transfer station D wherein the toner image is electrically removed from the drum surface and loosely bonded to the contacting side of the final support sheet.

Finally, any residual toner remaining on the drum after the transfer operation is completed is removed therefrom within a cleaning station E thus placing the photoconductive plate in a condition to be once again recycled through the automatic machine.

In the reproducing machine shown in the drawings, the sheets of final support material to be processed in the machine are stored in the machine frame within a removable paper cassette 15. Also, the reproducing machine shown has the capability of accepting and processing copy sheets of various lengths, the length of the sheet selected being dictated by the size of the original to be reproduced.

The individual sheets of support material are supported in a stacked configuration within the cassette and forwarded through the transfer station D in synchronous moving relationship with the visible toner image deposited on the drum. Sheet feeding is accomplished by means of a feed roll 16 and a sheet registering device 17. In operation, the feed roller 16 serves to separate the uppermost sheet from the stack and advance the sheet into the registration mechanism 17. Here, the motion of the leading edge of the sheet is momentarily interrupted while the sheet is properly aligned and registered with the image on the drum surface. The registering mechanism then advances the sheet into the transfer station D where the image is placed upon the copy sheet in the manner described above.

Upon completion of the transfer operation, the imaged sheet of final support material is forwarded to a xerographic fusing station F via a conventional belt transport 18 or any other suitable means. Within the fusing station, the xerographic toner image sup-

ported on the cut sheet is heated to a temperature sufficient to fix the toner image to the support material thus creating a permanent record of the information. Although any number of well known fixing techniques can be employed to produce the desired results, a conventional radiant heat fuser 21 is herein employed.

Referring now specifically to Figures 2 to 5, there is illustrated the sheet delivering and stacking apparatus in accordance with the present invention for aligning cut sheets of material in a stack configuration within a collecting tray. As more clearly seen in Figure 2, a pinch roll advancing assembly, generally referenced 30, is mounted above the sheet receiving and collecting tray 22 so that the sheets passing through the advancing nip formed between the cooperating pinch rolls is allowed to fall freely into the bottom of the tray.

The feed roll assembly comprises an upper roll sub-assembly including a series of idler rolls (i.e. roll members) 35 to 38 which are mounted for free rotation about a support shaft 40. Although not shown, both ends of the support shaft 40 are pivotally mounted within the machine frame so that the entire upper roll sub-assembly can be pivoted downwardly towards the lower sub-assembly. A pair of biasing springs 41, 42 are supported upon a stationary bracket 45 with the free ends of the springs riding in contact with bearing surfaces 46 carried in the upper roll sub-assembly. The spring elements urge the entire sub-assembly downwardly into contact with a lower pinch roll sub-assembly and provide sufficient nip pressure to hold a sheet of material introduced into the feed roll assembly in friction driving contact between the coaxing rolls.

The lower roll sub-assembly 32 is supported upon a shaft 46a rotatably mounted at each end in roller bearings contained within support brackets 47, 48. The right hand end of shaft 46a, as viewed in Figure 2, extends beyond the support bracket 48 and has a drive sprocket 50 affixed thereto. The sprocket is operatively attached to the main machine drive system via a chain (not shown) to turn the lower roll sub-assembly in the direction indicated.

A series of pinch rolls (i.e. roll members) 51 to 56 are coaxially aligned upon the shaft 46a and are adapted to turn therewith. In operation a sheet of support material introduced into the nip between the feed rolls is held in friction driving contact against the lower drive rolls by means of the biasing pressure imparted thereto via the upper roll sub-assembly thus causing the sheet to be driven in the direction indicated into the collecting tray.

Although not involved with the present invention, a sheet cutting system made up

of a multiple cutting blade, and support element 60 and a blade backing roller 61 is also contained within the assembly for slitting or perforating the sheets as they are advanced between the rolls. The sheet cutting system is more fully described in U.K. Patent Specification No. 1,423,770, to which the reader is referred.

As more clearly illustrated in Figures 3 to 5, the collecting tray includes an inclined main base plate 62 and an upwardly turned margin stop 63. Copy sheets, upon leaving the fuser assembly F, are initially engaged by a first set of advancing rolls 20 and are then forwarded along a guide plate 65 into the nip of the second advancing roll assembly 30 and subsequently deposited within the copy tray in the manner described above. As can be seen, the cut sheets of material leaving the advancing roll assembly 30 would normally drop onto the base plate of the tray and then slide downwardly into stack alignment against the margin stop 63. However, this gravity induced process has proven to be unreliable. In the case of high speed machines, the sheets tend to pile one upon the other in such rapid succession that the sheets become misaligned or "walk" out of the tray or back up into the feed roll assembly. The apparatus of the present invention provides a means by which each individual sheet delivered into the paper tray is actively engaged by a compact propelling mechanism which moves the sheet rapidly and efficiently into alignment against the stop 63. Furthermore, the present apparatus, because of its flexibility is relatively insensitive to any changes in stack height.

The propelling means shown in this embodiment of the invention is made up of three stacking elements 70 which are secured to the lower drive shaft 46a of the feed roll assembly. Although a specific number of flapper elements are herein utilized, it should be clear to one skilled in the art that other numbers of stacking elements can be employed in the practice of the present invention without departing from the teachings of the invention.

The stacking elements are interposed between the lower feed rolls and are affixed to the shaft 46a in the manner best illustrated in Figures 3 to 5. In practice, the stackers are formed of a relatively tough elastomeric material having resilient properties, such as polyurethane or the like. The elements are each provided with a hub portion 71 having a central aperture therein which permits the elastomeric element to be slipped over the drive shaft. The aperture formed in the hub is provided with a flat 72 which is capable of seating itself against a complementary flat machined on the shaft causing the stackers to be driven in a positive manner by the rotating shaft.

Extending from the hub 71 is an elongated arm or flapper 75 which normally extends outwardly from the hub in a substantially radial direction as seen in Figure 2. Initially, as the lower shaft rotates in the direction indicated, the normally extended arm 75 of the flapper is drawn into the feed roll nip in the manner illustrated in Figure 3. As shown, drawing the arm into the nip forces the resilient arm back into a deforming posture thus placing considerable stress upon the element. Further rotation of the shaft brings the free end or tip of the stressed flapper into the nip while at the same time placing the base or root of the arm well beyond a line extended from the feed roll shaft perpendicular to the base plate of the tray. At this time, the flapper is placed in what herein is referred to as a fully loaded condition preparatory to acting upon the uppermost sheet delivered into the collecting tray.

Further rotation of the shaft frees the tip of the flapper arm from between the pinch rolls thus allowing the arm to unload against the top sheet in the tray. The combined energy stored in the flapper, due to the driving action of the shaft and the force of deformation, is imparted to the sheet upon contact thus driving the sheet downwardly into a stack forming alignment against the stop 63. As can be seen, the circumference of the pinch rolls acting upon the copy sheets is considerably less than the length of the sheets individually. As a consequence, the flapper arm makes a multitude of contacts upon each sheet delivered into the tray thereby ensuring that the sheet will be properly aligned against the stop.

While this invention has been described with reference to the structure disclosed therein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the scope of the following claims.

#### WHAT WE CLAIM IS:—

1. Apparatus for delivering sheets of material into a collecting tray and aligning the sheets in a stacked configuration therein including

a feed roll assembly including a pair of cooperating rotating feed rolls being arranged to advance a sheet of material introduced into the nip formed therebetween into the collecting tray,

at least one resilient flapper element extending outwardly in a generally radial direction from one of said feed rolls and being arranged to rotate with said feed roll to strike each sheet delivered into said tray to effect alignment of the sheet within the tray,

said resilient element being mounted in said feed roll assembly such that the extended portion of the element is deformed

into a loaded condition as it is drawn into the nip and the element released, upon leaving the nip, whereby energy stored in the deformed member is imparted to the sheet upon contact.

2. Apparatus of the type wherein a pair of cooperating pinch rolls are arranged to advance sheets of material introduced therebetween into a sheet collecting tray, the apparatus including:

an elongated resilient member arranged to rotate with one of the rolls through the nip formed between said cooperating rolls, the resilient member extending outwardly in a generally radial direction from said one roll such that the free end of the resilient member is deformed as it is drawn through the nip and is subsequently released against the last sheet delivered into said collecting tray to effect alignment of said sheets within the tray.

3. The apparatus of Claim 2 wherein the elongated resilient member and said one of the rolls are coaxially aligned upon a common shaft.

4. The apparatus of Claim 3 wherein a plurality of elongated resilient members are mounted upon said shaft.

5. The apparatus of Claim 4 wherein the elongated resilient members are arranged to make a plurality of contacts against each sheet delivered into said collecting tray.

6. The apparatus of any one Claims 2 to 5 wherein the or each elongated resilient member is constructed of an elastomeric material.

7. The method of stacking sheets of material within a collecting tray including positioning an extended resilient member in close proximity to the collecting tray whereby the extended portion of the member is capable of contacting sheets delivered therein,

rotating the outwardly extending member whereby the extended portion of the member strikes each sheet delivered into said tray to register the sheet therein,

deforming the resilient member to a loaded condition prior to bringing the member into striking contact with the sheet, and

releasing the loaded member whereby the energy stored therein is imparted to the sheet upon contact.

8. A device for aligning sheets of material that are delivered into a collecting tray including

a rotating means positioned adjacent to the collecting tray having at least one resilient member operatively associated therewith being arranged to turn with the rotating means, the resilient member extending outwardly from said rotating means in a generally radial direction to contact a sheet of material delivered into said tray to propel the sheet into alignment,

- means to reform the resilient member into a loaded condition prior to the resilient member contacting said sheet, and means to release the deformed resilient member against the sheet whereby the energy stored within said resilient member is imparted to the sheet to effect alignment thereof.
- 5 9. Apparatus for aligning sheets of material delivered into a collecting tray, the apparatus being substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings. 10
- For the Applicants:—  
A. POOLE & CO.,  
Chartered Patent Agents,  
54 New Cavendish Street,  
London, W1M 8HP.

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COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of  
the Original on a reduced scale

Sheet 1

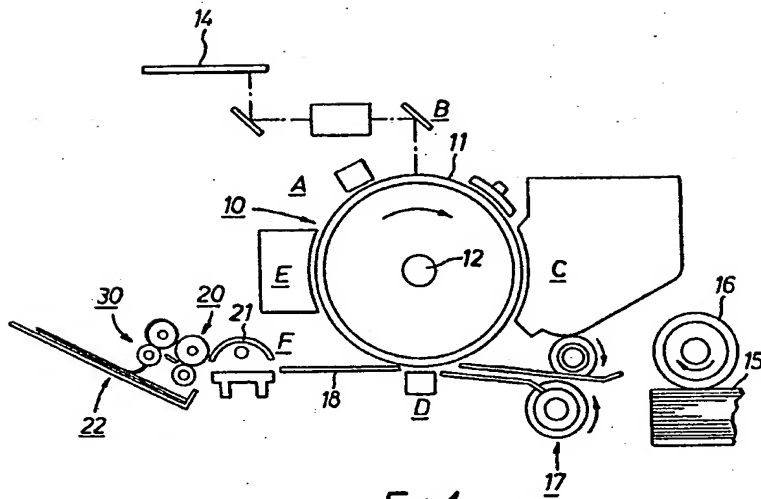


FIG. 1

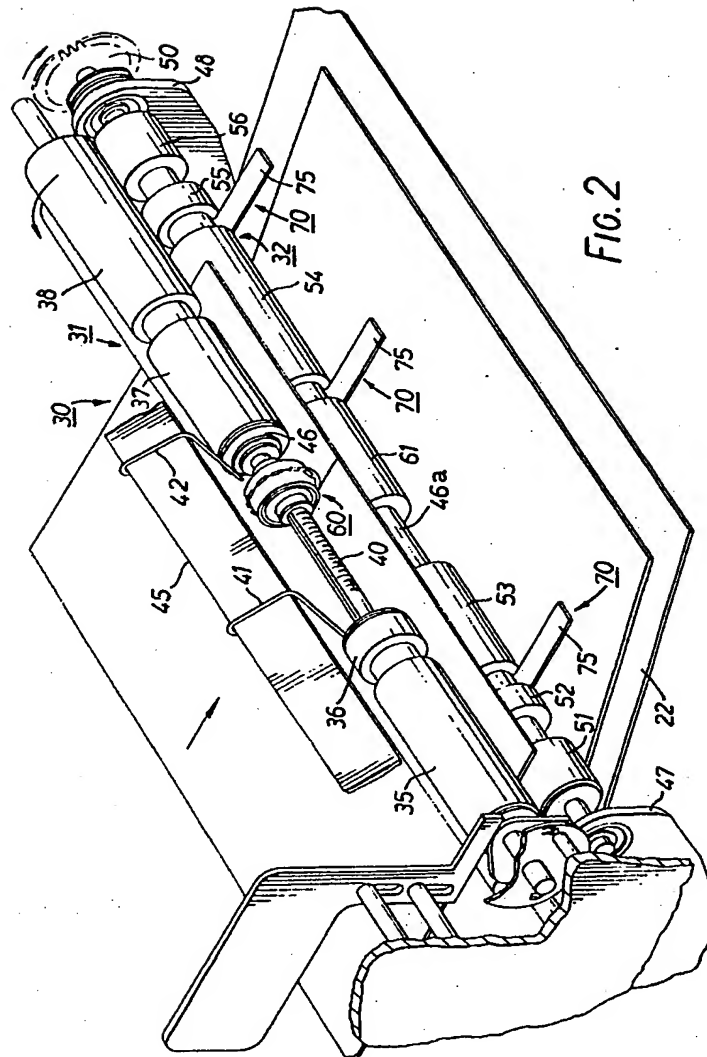
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COMPLETE SPECIFICATION

3 SHEETS

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Sheet 2



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